

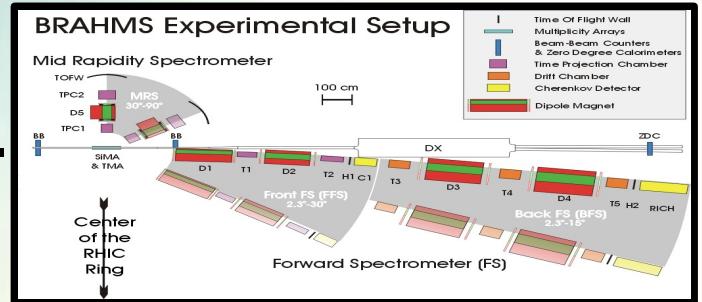


Rapidity Dependency of Coalescence in Au-Au Collisions at $\sqrt{s_{NN}} = 200 \text{ GeV}$

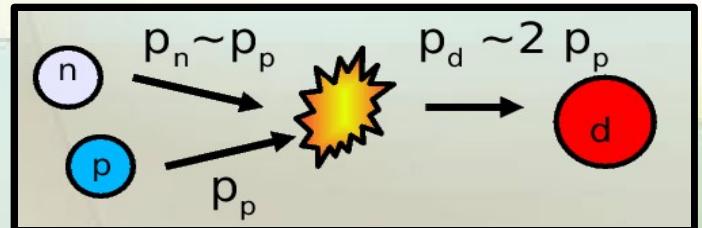
Casper Nygaard, Niels Bohr Institute
BRAHMS Collaboration

Outline

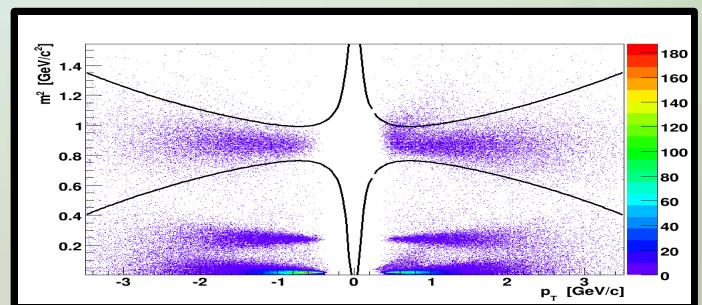
- The Brahms Experiment



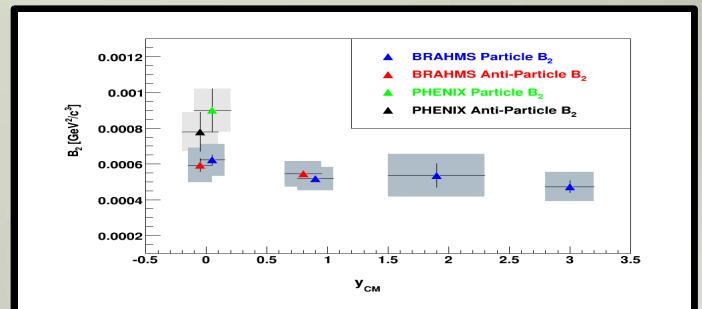
- Coalescence.....



- Analysis.....

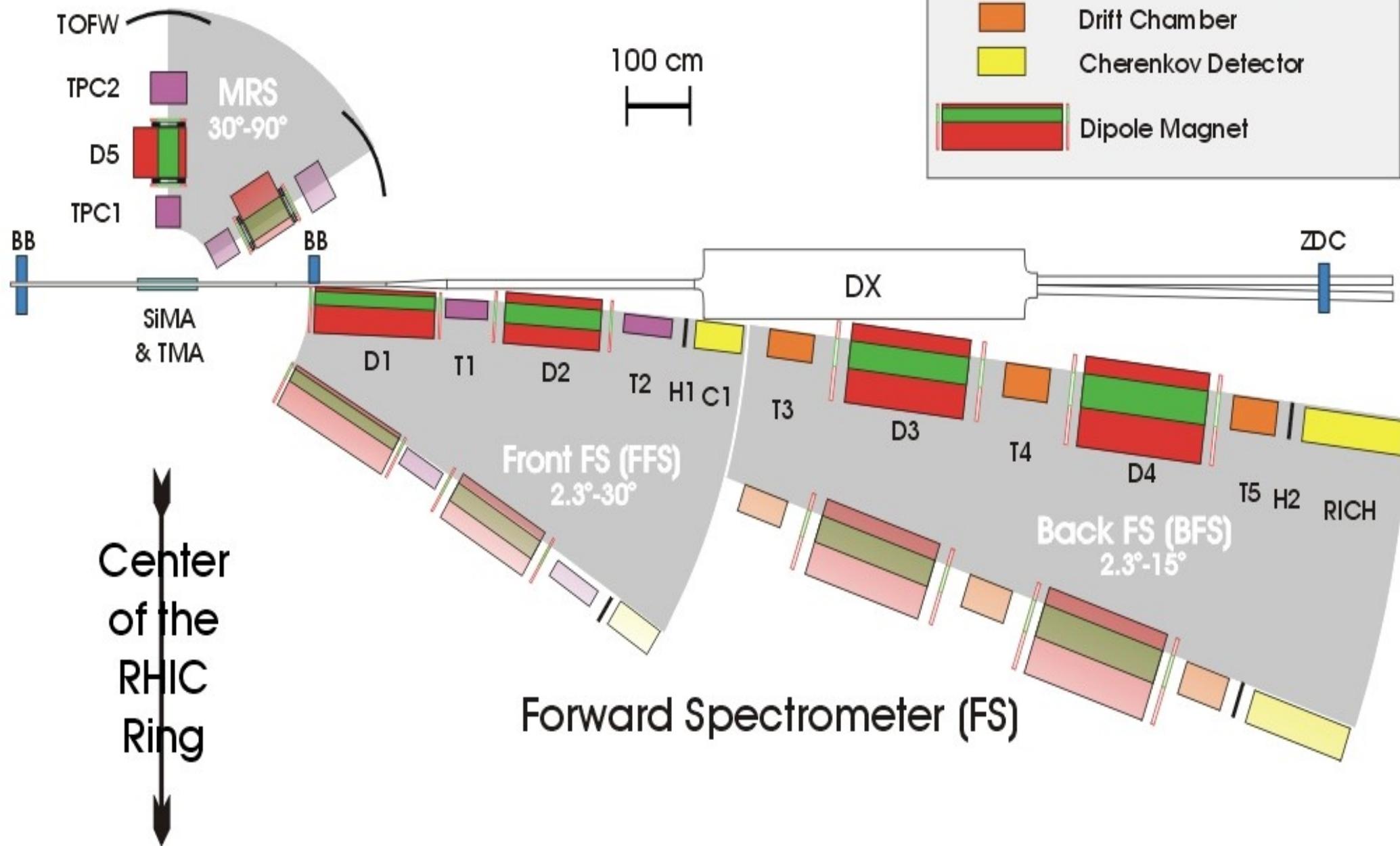


- Results.....



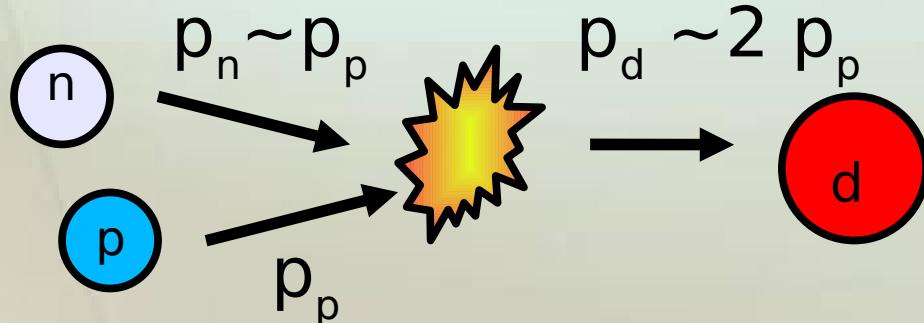
BRAHMS Experimental Setup

Mid Rapidity Spectrometer



Coalescence

- Deuteron coalescence is the creation of a deuteron, from a proton and a neutron.
- Due to the very low binding energy of the deuteron (2.22 MeV) , Coalescence probes the collision at the timescale of the freeze-out.
- Coalescence parameter given by:

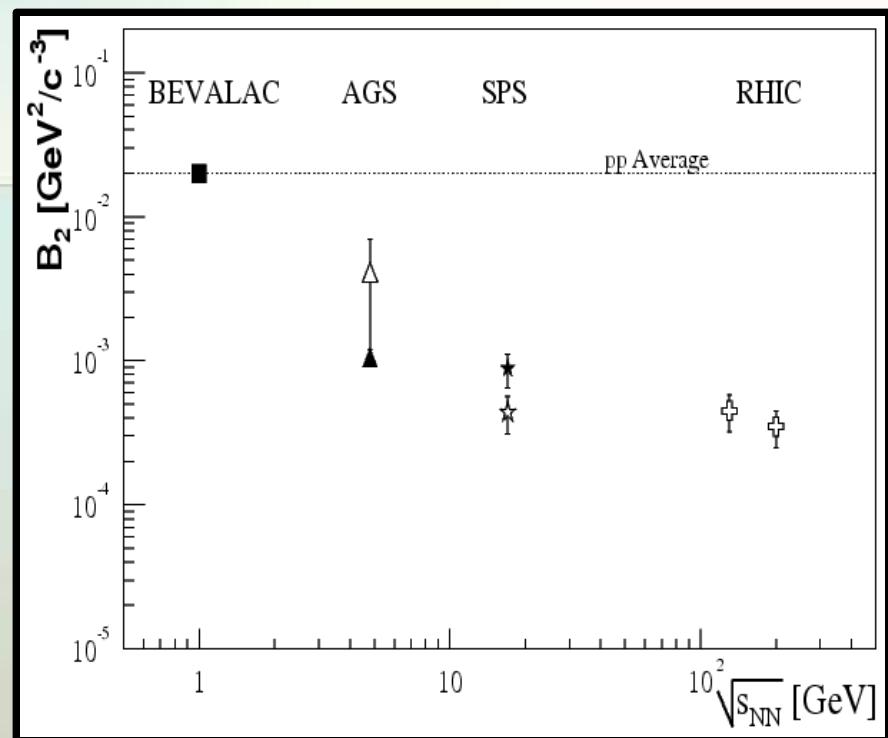


$$B_2 = \frac{E_d \cdot \left(\frac{d^3 N_d}{dp_d^3} \right)}{\left(\frac{E_p \cdot d^3 N_p}{dp_p^3} \right)_2}$$

- B_2 is inversely proportional to the collision volume according to various models. [Pearson]

Coalescence

- Previous Experiments show that B_2 decreases with collision energy.
- B_2 vs. p_T yields information on the transverse flow of the collision.
- B_2 at various rapidities will give an idea if the source size is changing when moving forward in rapidity.



Analysis

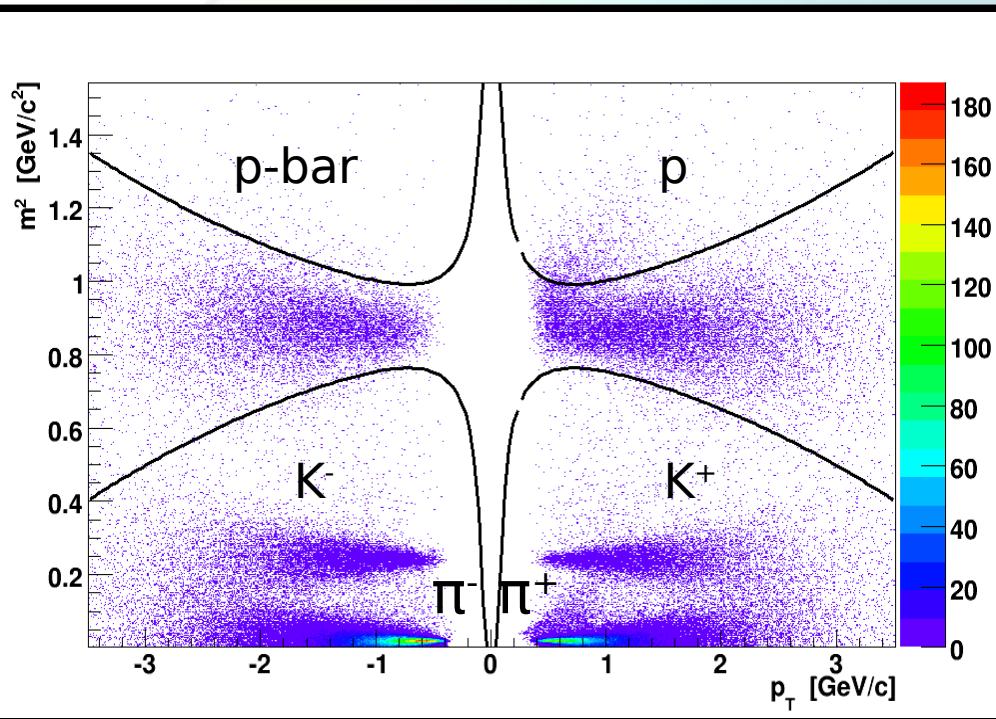
Collision Energy: 200 GeV
Collision Species: Au + Au
Centrality: 0-20% central

Rapidity Slices :

- y = [-0.1;0.1] ($\theta \sim 90^\circ$)
- y = [0.7;1.0] ($\theta \sim 40^\circ$)
- y = [1.5;2.4] ($\theta \sim 8-10^\circ$)
- y = [2.8,3.2] ($\theta \sim 2.3-4^\circ$)

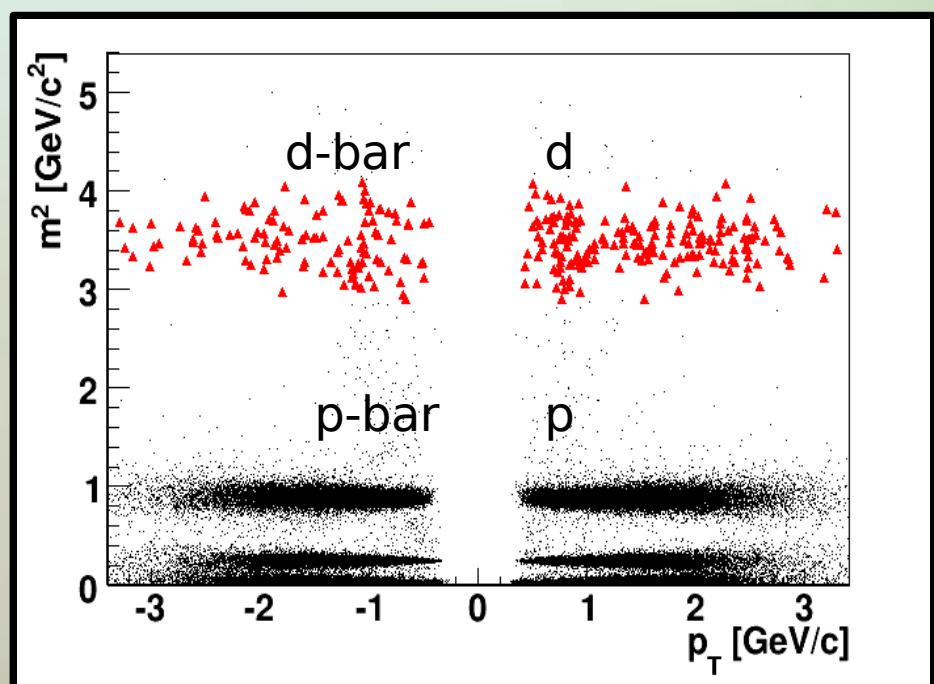
Data taken by BRAHMS at the RHIC in Run4 in 2004

TOF PID



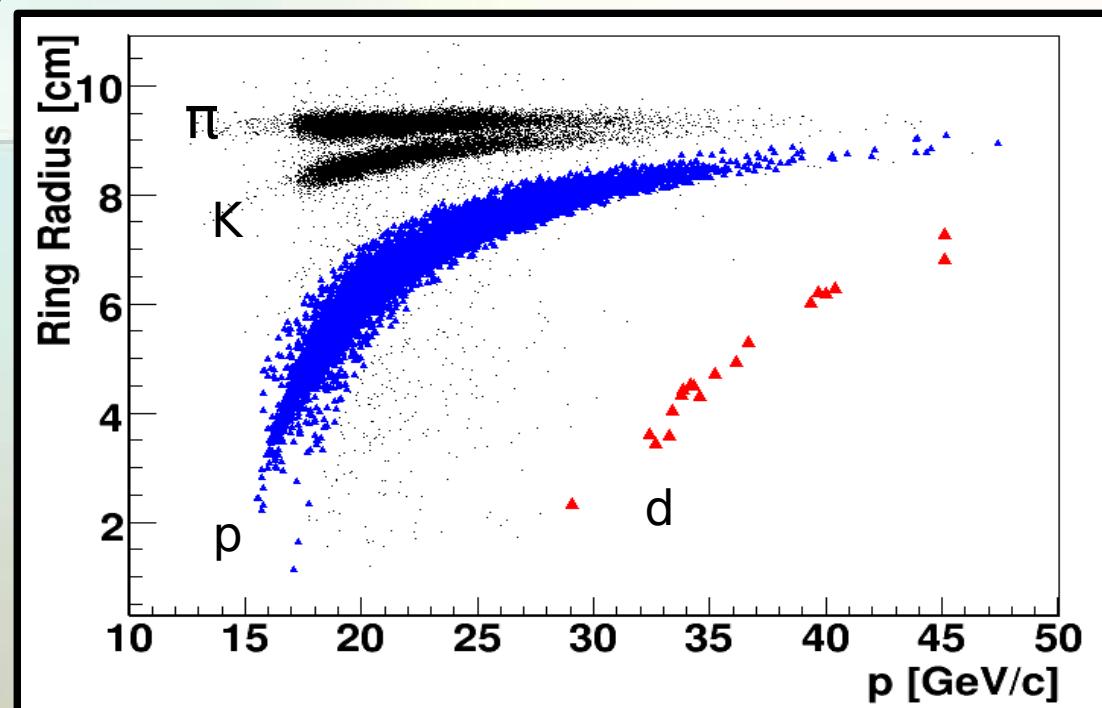
- TOF PID used in the MRS and in combination with the RICH at $y \sim 2$.

- Proton PID done by fitting the m^2 vs. p_T distribution.
- Deuteron PID done by a gaussian fit in the m^2 distribution.



RICH PID

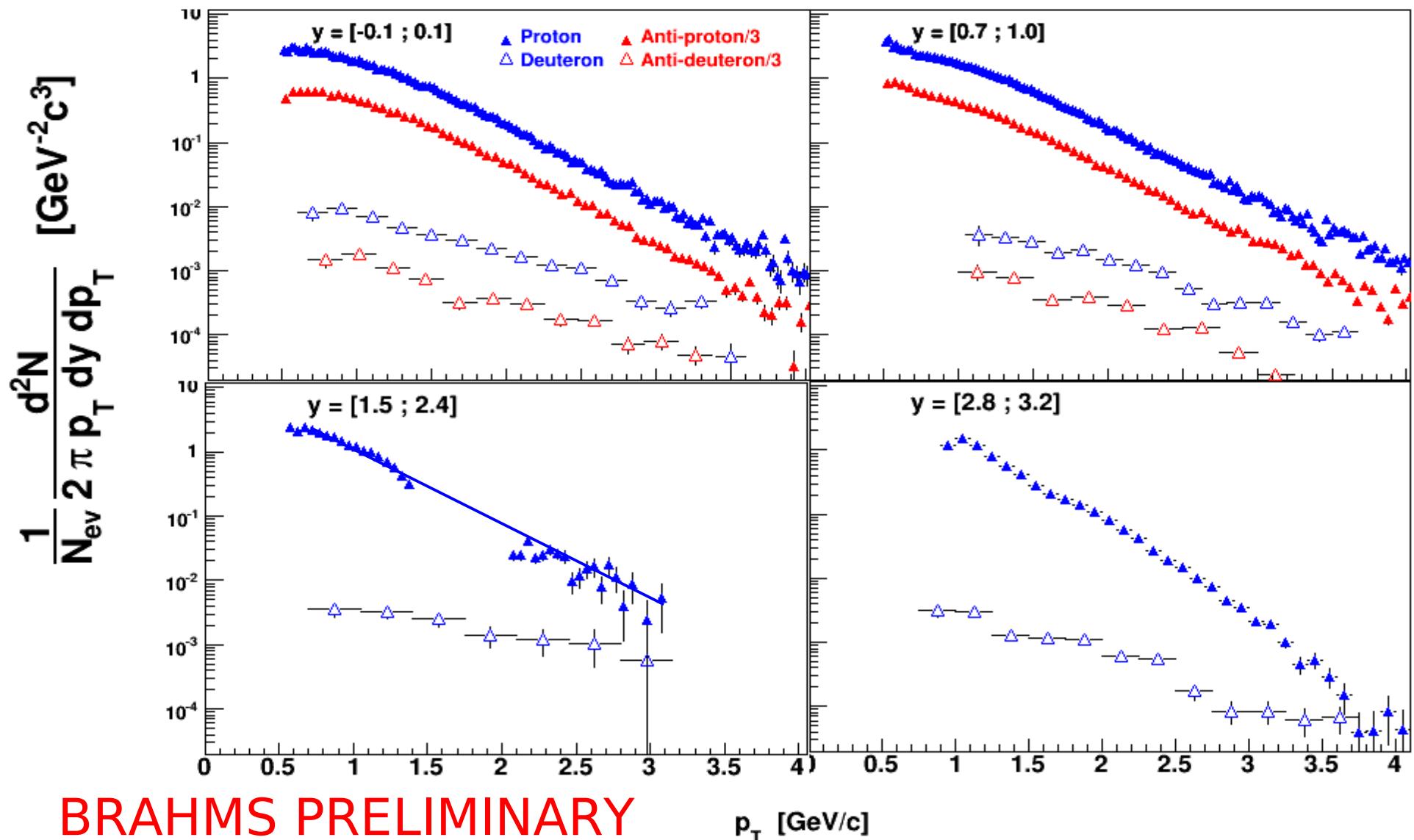
- Proton PID
 - Direct: From $p \sim 15$ GeV/c, the Cherenkov ring radius is used
 - Indirect: $12 > p > 17$ GeV/c
- Deuteron PID
 - Direct: From $p \sim 30$ GeV/c
 - Indirect: $17 > p > 24$ GeV/c
- Used for PID at $y \sim 3$ and in combination with the TOFs at $y \sim 2$.



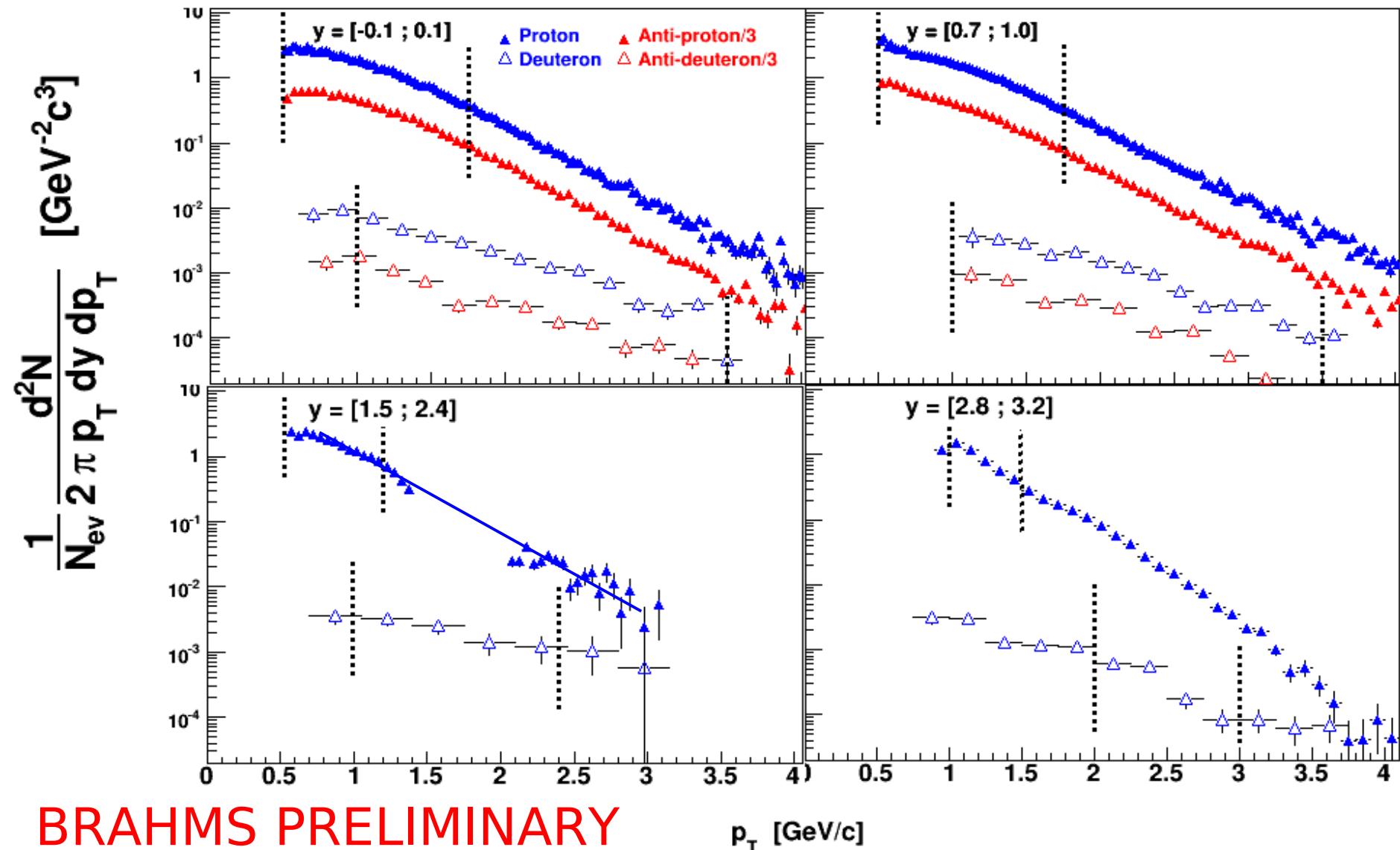
Spectra

- The invariant spectra have been corrected for:
 - Acceptance
 - Tracking efficiency
 - Multiple scattering, absorption and weak decay for (anti)-protons by GEANT
 - GEANT does not handle anti-deuterons, and does not handle hadronic interactions for deuterons.
 - Deuteron correction approximated to:
$$\text{Eff}(p_d)_{d/d\bar{p}} = \text{Eff}(p_d)_{\text{GEANT}(d)} * (\text{Eff}(p_d/2)_{\text{GEANT:hadronic}(p/p\bar{p})})^2$$

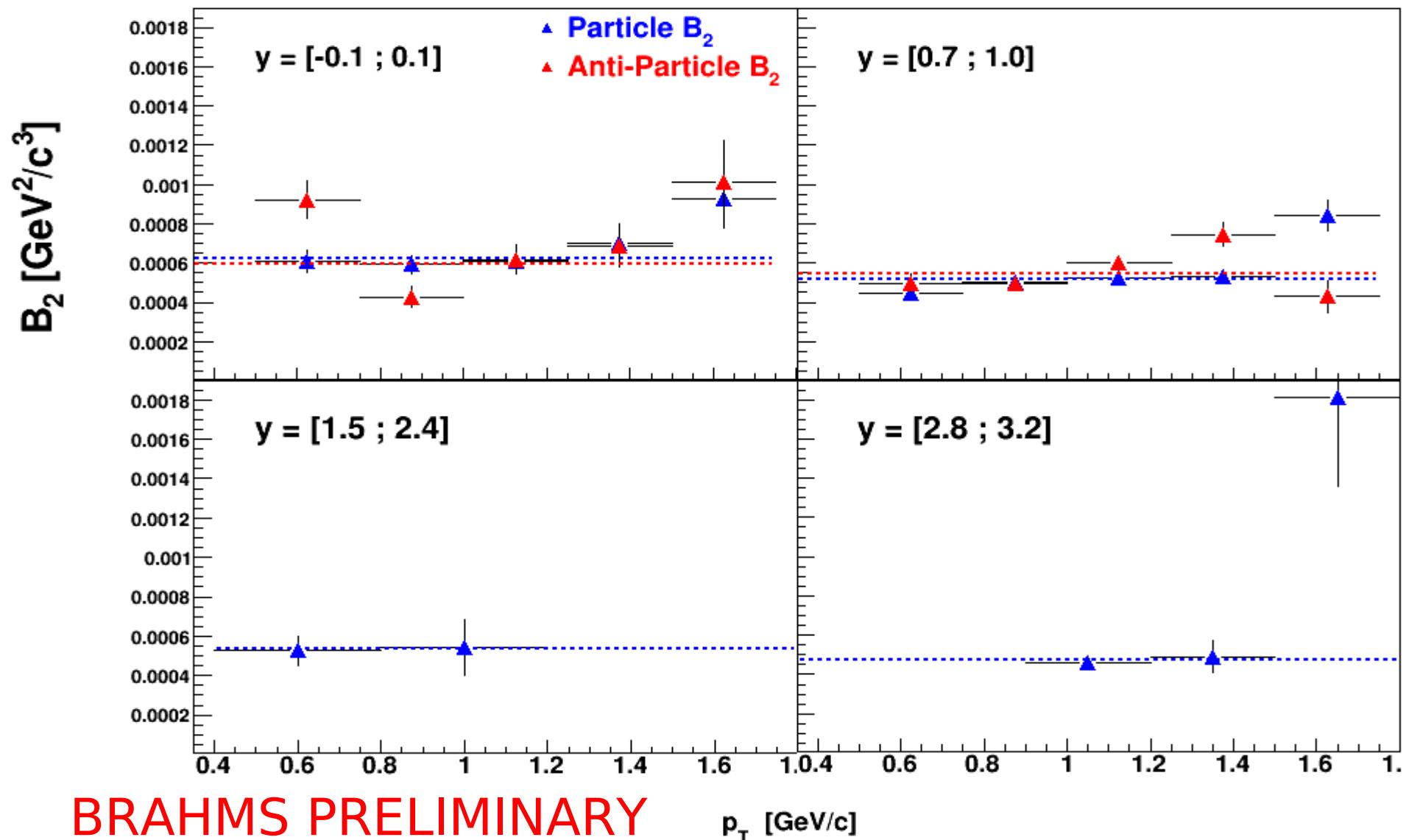
Spectra



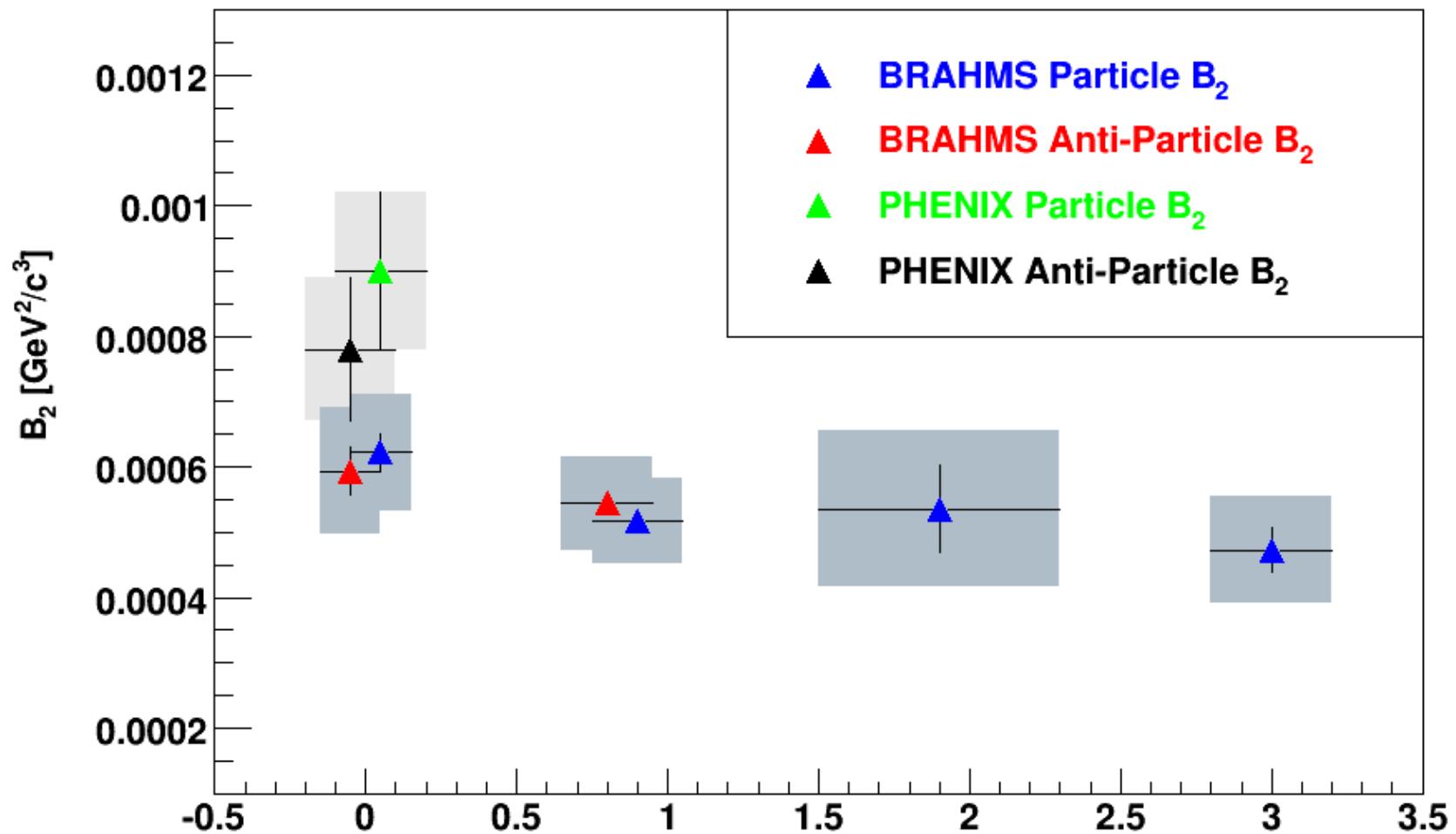
Spectra



B_2 VS. p_T

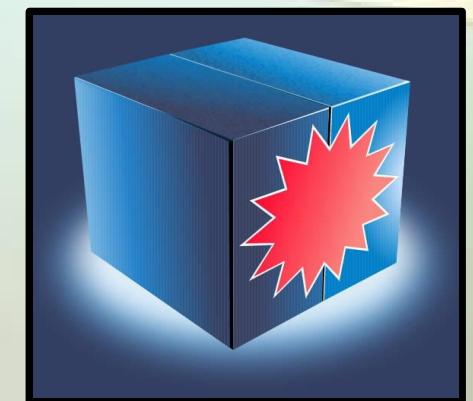
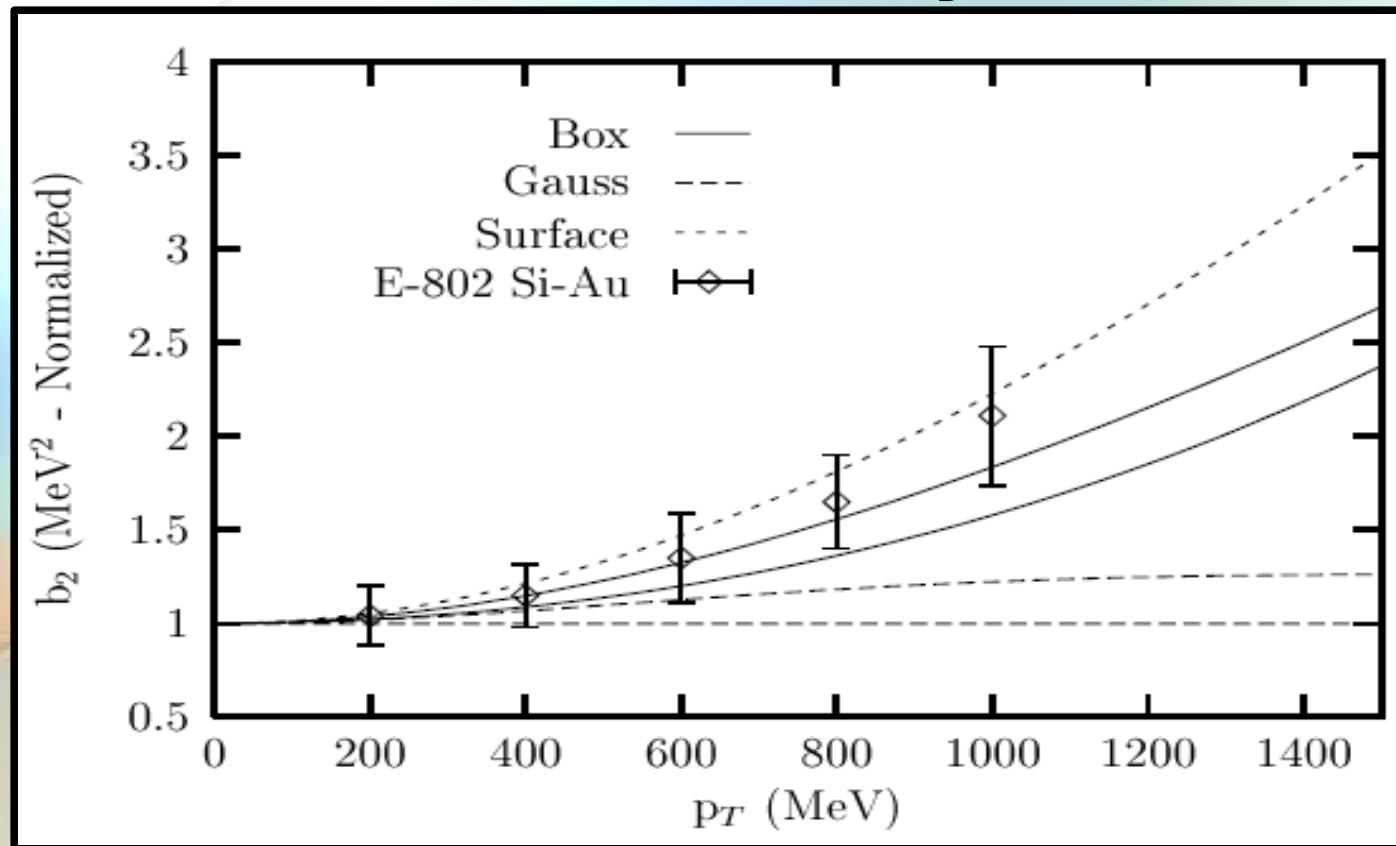


B_2 VS. y



BRAHMS PRELIMINARY y_{CM}

Density Profile



Simulation for different density and flow profiles [Polleri]



Summary

- B_2 increases as a function of p_T at $y \sim 0$ (and maybe $y \sim 1$).
- B_2 is constant within errors in the rapidity range $y \sim [0; 3]$, indicating that source sizes are comparable at these rapidities.

Outlook

- Further studies trying to single out which density profile best describes the data.
- Study of B_2 vs. y , for various centralities and systems (e.g. Cu+Cu and p+p).

Finally....

- Happy 25th birthday Art!



BRAHMS Collaboration

**I. C. Arsene¹², I. G. Bearden⁷, D. Beavis¹, S. Bekele¹², C. Besliu¹⁰, B. Budick⁶,
H. Bøgild⁷, C. Chasman¹, C. H. Christensen⁷, P. Christiansen⁷, H.H.Dalsgaard⁷, R. Debbe¹,
J. J. Gaardhøje⁷, K. Hagel⁸, H. Ito¹, A. Jipa¹⁰, E.B.Johnson¹¹, J. I. Jørdre⁹,
C. E. Jørgensen⁷, R. Karabowicz⁵, N. Katrynska⁵, E. J. Kim¹¹, T. M. Larsen⁷, J. H. Lee¹,
Y. K. Lee⁴, S. Lindahl¹², G. Løvhøiden¹², Z. Majka⁵, M. J. Murray¹¹, J. Natowitz⁸, C.Nygaard⁷
B. S. Nielsen⁸, D. Ouerdane⁸, D.Pal¹², F. Rami³, C. Ristea⁸, O. Ristea¹¹,
D. Röhrich⁹, B. H. Samset¹², S. J. Sanders¹¹, R. A. Scheetz¹, P. Staszek⁵,
T. S. Tveter¹², F. Videbæk¹, R. Wada⁸, H. Yang⁹, Z. Yin⁹, I. S. Zgura²**

1. Brookhaven National Laboratory, Upton, New York, USA
2. Institute of Space Science, Bucharest - Magurele, Romania
3. Institut Pluridisciplinaire Hubert Curien et Université Louis Pasteur, Strasbourg, France
4. Johns Hopkins University, Baltimore, USA
5. M. Smoluchowski Institute of Physics, Jagiellonian University, Krakow, Poland
6. New York University, New York, USA
7. Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark
8. Texas A&M University, College Station, Texas, USA
9. University of Bergen, Department of Physics and Technology, Bergen, Norway
10. University of Bucharest, Romania
11. University of Kansas, Lawrence, Kansas, USA
12. University of Oslo, Department of Physics, Oslo, Norway